Self-organization of droplets and buckling of droplet chains in free-standing liquid crystalline films(Soft Matter as Structured Materials)

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While nematic liquid crystals are good models for anisotropic bulk emulsions [1], free-standing films represent a convenient model for two-dimensional systems. Here free-standing smectic films are investigated at the transition from the smectic C phase to the isotropic phase. In the vicinity of the bulk transition temperature isotropic droplets of micrometer size appear in the film. A characteristic feature of the droplets is their mutual interaction by elastic distortions of the c-director [2, 3]. The director deformations created by isotropic droplets of different sizes are discussed. Depending upon droplet size and anchoring conditions, topological defects can be induced in the c-director field.

The isotropic droplets can interact and self-organize in different patterns, like chains, lattices and rings. If the c-director field in a free-standing film is prepared as a target pattern with a continuous radial deformation, the droplets align tangentially in regular chains in the structure of the c-director field. Incorporation of additional droplets lengthens the chains at given ring diameter until they form complete rings. Further chain growth introduces a reversible buckling-instability (see Fig. 1) with a characteristic wavelength [4]. The phenomenon is similar in many respects to growth processes in biological systems or Euler buckling in polymer foils.

References

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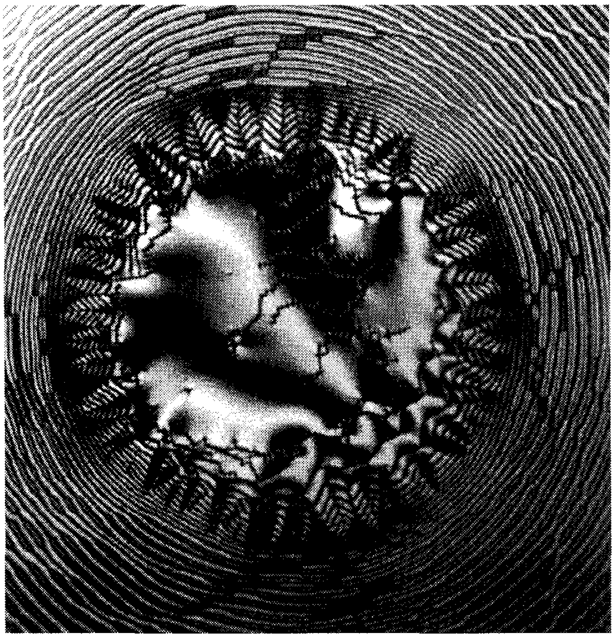

Figure 1: Buckling of isotropic droplet chains in a target pattern of the c-director field. The width of the image is 655.2 μm. Individual droplets in the chains are only resolved in the central part of the image; otherwise the chains are recognized by dark lines. The innermost rings are replete and start to develop a modulation pattern with characteristic wave length.

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